National Risk Management Research Laboratory
www.epa.gov/nrmrl

GREEN INFRASTRUCTURE RESEARCH PROGRAM

Providing Research Solutions to Manage Wet-Weather Flow

Porous Pavement

Introduction

Porous pavement provides stormwater runoff reduction through infiltration. In a porous pavement system, stormwater runoff moves through several layers of bedding after passing through the porous surface and infiltrates into the subgrade soil. Some pollutants may be removed as the water moves through the underlying materials. The most commonly-used permeable surfaces are porous asphalt, porous concrete, and interlocking concrete pavers, which are often called porous pavers although the pavers themselves are not porous. Porous pavement systems can reduce the impact of stormwater on receiving waters by reducing runoff volumes and decreasing and delaying peak flows. Porous pavement systems serve two low-impact development purposes as they both reduce impervious area and infiltrate stormwater runoff.

Background

The National Risk Management Research Laboratory (NRMRL) is evaluating porous pavement as part of a larger collection of long-term research examining multiple stormwater management practices. The U.S. EPA recognizes the potential of porous pavement systems as a green infrastructure management tool to lessen the effects of peak flows on aquatic resources.

While the installation of porous pavement systems has become more prevalent, there is a lack of full-scale, outdoor, real-world porous pavement research with system replicates. More studies of porous pavement operating in its intended use (parking lot, roadway, etc.) with climatic events, regular use, and maintenance effects are necessary.

Objectives

The Green Infrastructure Research Program's long-term porous pavement research addresses several objectives. The overall objective of the project is to document the performance and capabilities of three porous pavement systems simultaneously at the same site with replicates that allow for statistical analyses. The parking lot will be monitored for hydrologic performance, water quality performance, urban heat island mitigation, maintenance effects, and parking behavior in the lot.

Current Research

The experimental design of the parking lot is shown in Figure 1. There are five parking rows in this 110-parking space lot and four of them are instrumented for long-term monitoring. Moving from north to south, the parking row surfaces are: porous concrete (not monitored), interlocking concrete pavers, porous concrete, porous asphalt, and conventional asphalt. The porous concrete parking row at the northern end of the lot is necessary to ensure that each of the monitored sections receives runoff from the same drainage area. The order of the porous surfaces was chosen randomly. The runoff generated by the conventional asphalt at the southern end of the parking lot will feed the rain gardens via curb cuts and will also serve as an experimental control. The roof runoff from an adjacent building will also be piped to the rain gardens, so as not to add runoff to the parking lot. Each of the monitored porous pavement parking rows has subsections lined with an impermeable geotextile fabric to collect the infiltrating water as well as sections that infiltrate into the underlying soil. There are four impermeable (darker sections of each parking row) and five permeable sections (lighter sections of each parking row) for each porous pavement type, which allows for statistical analyses of data. Each impermeable section has a perforated pipe that drains the accumulated runoff through pipes under the roadway to a dedicated collection tank on the eastern side of the lot; consequently, there are a total of twelve storage tanks.

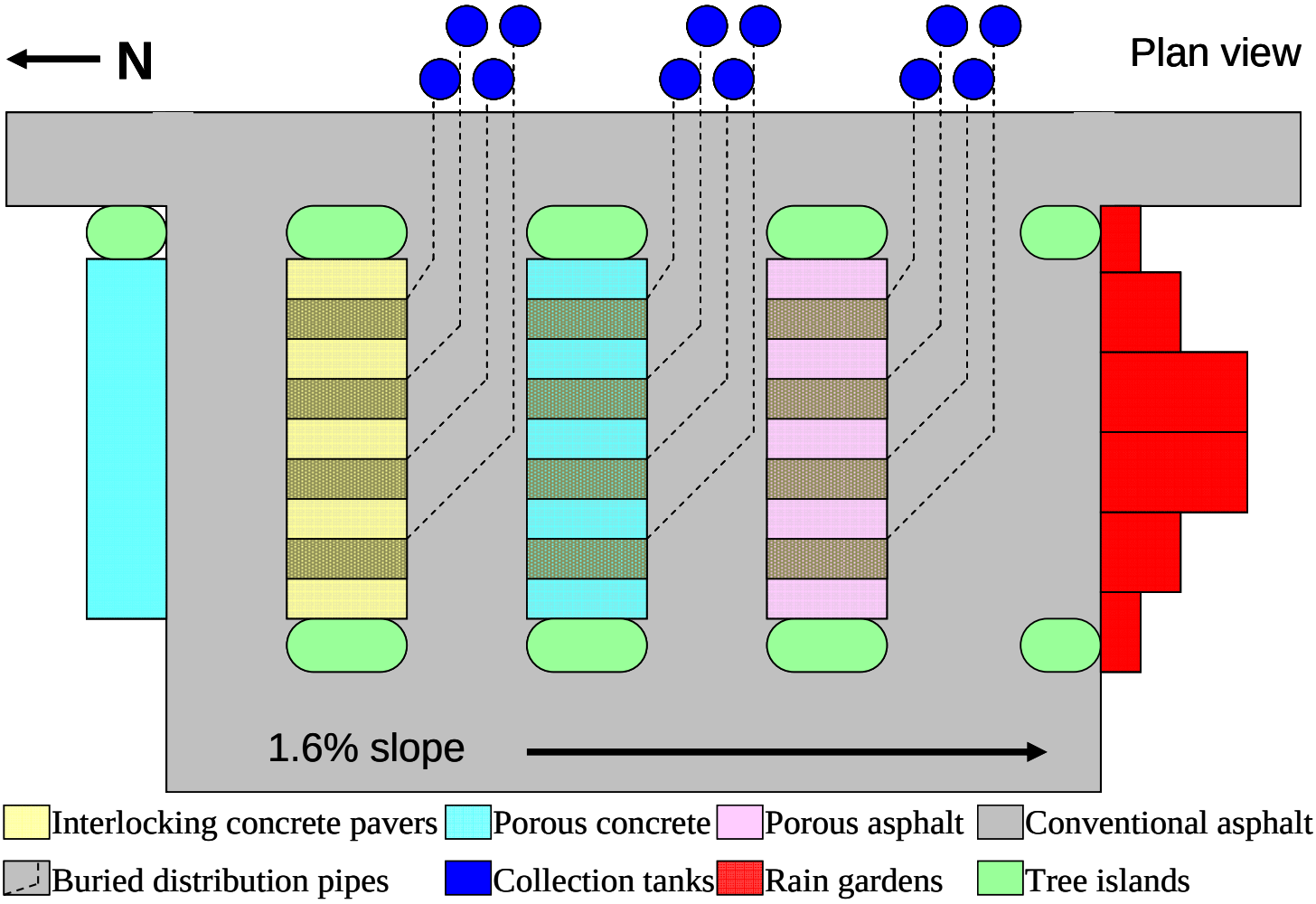

Figure 1. Plan view of the porous pavement parking lot at the Edison Environmental Center. (After Morris Ritchie and Associates, 2009)

The unlined sections at the ends of each monitored porous surface parking row will allow for the monitoring of the interaction of the infiltrated water with the subgrade soil. The unlined sections are instrumented with permanent equipment as well as access pipes that allow for the placement of instruments for event-based sampling. The instruments in the unlined sections will monitor accumulated water depth, wetting front passage, and temperature throughout the porous pavement profile. The lined parking sections are not instrumented, but the infiltrating water will be collected via the buried distribution pipes and will allow for the measurement of infiltrated water volume, rate of infiltration, and analysis of selected water quality parameters including: solids, microbes, nutrients, metals, and semi-volatile organic compounds.

Impacts

The parking lot at the Edison Environmental Center will permit the investigation of a number of topics relative to the design and performance of porous pavement systems. The project is unique, not only due to the three side-by-side permeable surfaces but also because of the planned long-term monitoring, the extent of the installed instrumentation, the scale, the division of the parking rows for replicates, and the direct monitoring of volume and flow rate. Measurements will be taken under controlled conditions while the lot is actively used for employee parking. The porous pavement parking lot is a demonstration site that will be used as an educational tool to show how porous pavement works. It will also contribute to "greening" the EPA's Edison facility and will illustrate that porous pavement can provide effective stormwater management. The results of this study will provide much needed design and performance information to the regulated community to enable better decisions associated with their stormwater management programs.

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